GPM L3GPROF (Version 05)

Description:

The L3GPROF algorithm provides monthly and daily mean precipitation and related retrieved parameters from the Level 2 GPROF precipitation profiling algorithm for the GPM core and constellation satellites.

Each 3GPROF product contains global 0.25 degree x 0.25 degree gridded monthly/daily unconditional means and pixel counts. Monthly product filename starts with 3A-MO and daily product starts with 3A-DAY. For example,
3A-MO.GPM.GMI.GRID2017R1.20161201-S000000-E235959.12.V05A.HDF5
3A-DAY.GPM.GMI.GRID2017R1.20161201-S000000-E235959.336.V05A.HDF5

Current available 3GPROF V05 products are listed in the following table:

Product Id	Radiometer	Satellite
3GPROF	AMSR2	GCOME-W1
3GPROF	ATMS	NPP
3GPROF	GMI	GPM
3GPROF	MHS	NOAA-18 NOAA-19 METOP-A METOP-B
3GPROF	SSMIS	F16 F17 F18 F19
3GPROF	TMI	TRMM
3GPROF	AMSRE	AQUA
3GPROF	AMSUB	NOAA-15 NOAA-16 NOAA-17
3GPROF	SSMI	F11 F13 F14 F15

Because this product is an accumulation of the Level 2 GPROF retrieval products, much more information is available via the GPROF Level 2 ATBD and file specification documents.

Product Content:

All 3GPRO products have the same data structure and are in HDF5 format.
Accumulations are done for each grid over the desired accumulation period (a month or a day) and only pixels with a pixelStatus=0 (indicates valid pixel) in the L2 input files are included in the calculation.

nlat=720   Number of 0.25 degree grid intervals of latitude from 90S to 90N.
nlon=1440 Number of 0.25 degree grid intervals of longitude from 180W to 180E.
nlayer=28 Number of profiling layers. The top of each layer is 0.5, 1.0, 1.5,...9.5, 10.0, 11.0,...,18.0 km. The layer tops are heights above the earth's surface.

npixTotal (4-byte integer, array size: nlat x nlon):
The total number of pixels for each grid.

npixPrecipitation (4-byte integer, array size: nlat x nlon):
The total number of pixels with *surfacePrecipitation > 0 for each grid.*

surfacePrecipitation (4-byte float, array size: nlat x nlon, unit: mm/hr):
The mean of the instantaneous precipitation rate at the surface for each grid.
totalPrecip = sum of surface precipitation
surfacePrecipitation = totalPrecip /npixTotal

convectivePrecipitation (4-byte float, array size: nlat x nlon, unit: mm/hr):
The mean of the instantaneous convective precipitation rate at the surface for each grid.
totalConvectPrecip = sum of convective precipitation
convectivePrecipitation = totalConvectPrecip /npixTotal

frozenPrecipitation (4-byte float, array size: nlat x nlon, unit: mm/hr):
The mean of the instantaneous frozen precipitation rate at the surface for each grid.
totalFrozenPrecip = sum of frozen precipitation
frozenPrecipitation = totalFrozenPrecip /npixTotal

rainWaterPath (4-byte float, array size: nlat x nlon, unit: kg/m^2):
The mean of the total integrated rain water in the vertical atmospheric column for each grid.
totalRainWaterPath = sum of rain water path
rainWaterPath = totalRainWaterPath /npixTotal

cloudWaterPath (4-byte float, array size: nlat x nlon, unit: kg/m^2):
The mean of the total integrated cloud water in the vertical atmospheric column for each grid.
totalCloudWaterPath = sum of cloud water path
cloudWaterPath = totalCloudWaterPath /npixTotal

iceWaterPath (4-byte float, array size: nlat x nlon, unit: kg/m^2):
The mean of the total integrated ice water in the vertical atmospheric column for each grid.
totalIceWaterPath = sum of ice water path
iceWaterPath = totalIceWaterPath /npixTotal

rainWater (4-byte float, array size: nlat x nlon x nlayer, unit: g/m^3):
The mean of the rain water content for each grid at each vertical layer.
A pixel's rain water content value is recovered from the following L2 parameters:
cn=profileNumber(s)   ; s is the specie index, for rainWater s=1
T=temp2mIndex;
cp=clusterProfiles(s,T,layer,cn)
cs=profileScale(s)
rain water content = cs*cp

totalRainWater = sum of rain water content
rainWater = totalRainWater/npixTotal

cloudWater (4-byte float, array size: nlat x nlon x nlayerunit: g/m^3):
The mean of the cloud liquid water content for each grid at each vertical layer.
A pixel's cloud water content value is recovered from the following L2 parameters:
cn=profileNumber(s)   ; s is the specie index, for cloudWater s=2
T=temp2mIndex;
cp=clusterProfiles(s,T,layer,cn)
cs=profileScale(s)
cloud water content = cs*cp

totalCloudWater = sum of cloud water content
cloudWater = totalCloudWater/npixTotal

cloudIce (4-byte float, array size: nlat x nlon x nlayerunit: g/m^3):
The mean of the cloud ice water content for each grid at each vertical layer.
A pixel's cloud ice water content value is recovered from the following L2 parameters:
cn=profileNumber(s)   ; s is the specie index, for cloudIce s=3
T=temp2mIndex;
cp=clusterProfiles(s,T,layer,cn)
cs=profileScale(s)
cloud ice water content = cs*cp

totalCloudIce = sum of cloud ice water content
cloudIce = totalCloudIce/npixTotal

snow (4-byte float, array size: nlat x nlon x nlayerunit: g/m^3):
The mean of the snow liquid water content for each grid at each vertical layer.
A pixel's snow liquid water content value is recovered from the following L2 parameters:
cn=profileNumber(s)   ; s is the specie index, for snow s=4
T=temp2mIndex;
cp=clusterProfiles(s,T,layer,cn)
cs=profileScale(s)
snow liquid water content = cs*cp

totalSnow = sum of snow liquid water content
snow = totalSnow/npixTotal

surfaceTypeIndex (4-byte integer, array size: nlat x nlon):
Indicates the type of surface (Range 0 – 99) for each grid.
Codes include
1 : Ocean
2 : Sea-Ice
(3-12 are ’land classification’)
3 : Maximum Vegetation
4 : High Vegetation

5 : Moderate Vegetation
6 : Low Vegetation
7 : Minimal Vegetation
8 : Maximum Snow
9 : Moderate Snow
10 : Low Snow
11 : Minimal Snow
12 : Standing Water and Rivers
13 : Water/Land Coast Boundary
14 : Water/Ice Boundary
15 : Land/Ice Boundary
60 : Multiple surface types
-99 : Missing value

totalType = sum of surface type index for each grid
surfaceTypeIndexAve = totalType/npixelTotal

if surfaceTypeIndexAve has an integer value (eg, 1.0, 2.0, 4.0, …) then
surfaceTypeIndex=surfaceTypeIndexAve,
otherwise
surfaceTypeIndex=60 (Multiple surface types).

fractionQuality0 (4-byte float, array size: nlat x nlon):
The fraction of the retrieved pixels in a given grid box identified as good retrievals. For regions where there are no retrieval issues this will be 1.0. Areas with surface screening or contamination issues with questionable retrievals during the accumulation period will have values less than one and should thus be used with caution for any quantitative analysis. Values range from 0 to 1.
totalQuality0 = total number of pixels with QualityFlag=0
fractionQuality0 = totalQuality0/npixTotal

fractionQuality1 (4-byte float, array size: nlat x nlon):
The fraction of total pixels with qualityFlag equal to 1 (use with caution) for each grid. Values range from 0 to 1.
totalQuality1 = total number of pixels with QualityFlag=1
fractionQuality1 = totalQuality1/npixTotal

fractionQuality2 (4-byte float, array size: nlat x nlon):
The fraction of total pixels with qualityFlag equal to 2 (use with extreme care over snow covered surface) for each grid. Values range from 0 to 1.
totalQuality2 = total number of pixels with QualityFlag=2
fractionQuality2 = totalQuality2/npixTotal

fractionQuality3 (4-byte float, array size: nlat x nlon):
The fraction of total pixels with qualityFlag equal to 3 (use with extreme caution) for each grid. Values range from 0 to 1.
totalQuality3 = total number of pixels with QualityFlag=3
fractionQuality3 = totalQuality3/npixTotal

Caveats/Limitations

The primary limitation of the 3GPROF product is the reliance on a single sensor for each output file, thus limiting the available sampling to two times a day or less, except at high latitudes. In addition, with the exception of the GMI, TMI, and SAPHIR sensors, all of the other sensors are in Sun-synchronous orbits, meaning that they observe a given point on the Earth's surface at the same local times each day. Over land regions in particular, this can lead to large sampling errors associated with the diurnal cycle.

Errors due to the limited sampling and differences in the sampling times between Sun-synchronous satellites (e.g., F16, F17, F18, F19, NOAA-18, NOAA-19, NPP, METOP-A, METOP-B, and GCOM-W1) can lead to significant differences in the monthly mean values between satellites/sensors. The sampling errors are largest over land regions with large diurnal cycles in precipitation.

Other sources of error that can significantly impact the 3GPROF products include difficulties over certain surface types such as sea ice, snow, frozen ground, and deserts, and limited sensitivity of the sounder instruments (in particular to light precipitation and/or shallow warm rain systems). The sounders include the ATMS, MHS, and SAPHIR sensors, which do not have channels with sensitivity to the surface and/or lower atmosphere.

References:

1. PPS/Global Precipitation Measurement File Specification for GPM Products.
2. GPM GPROF (Level 2) Algorithm Theoretical Basis Document

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